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ABSTRACT

This classroom unit was developed for use in grades 4-6 to help teach the concept of solid waste management. The teacher's guide provides an overview of the issue of solid waste disposal, a description of government, industry, and consumer roles in resolving the solid waste issue, and four lessons involving sanitary landfills, the reduction of garbage, recycling and composting, and utilizing solid waste incineration to produce energy. Separate support materials include an interactive wall chart, four student worksheets related to the four lesson topics, a crossword puzzle to assess students' knowledge of the solid waste issue, a take-home activity to encourage parent involvement, charts and graphs appropriate as overhead visuals, and a student evaluation card. (MDH)

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ED 367 549

PLANET PATROL

An Environmental Unit on Solid Waste Solutions For Grades 4–6

SE 053 216

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PLANET PATROL

AN EDUCATIONAL UNIT ON SOLID WASTE SOLUTIONS

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Description of Support Materials

To help teach the concept of solid waste management, you will find the enclosed program support materials:

Planet Patrol Wall Chart

This interactive teaching tool features children of the Planet Patrol and their families demonstrating environmentally responsible behaviors. The chart illustrates methods for solid waste handling, and provides examples of many products that can be recycled, made from recycled materials or composted.

Teacher's Lesson Guide for Planet Patrol

This 16-page booklet provides comprehensive lesson plans and activities focusing on integrated solid waste management. In addition to giving teachers an overview of the solid waste issue, each of the four lesson plans in the booklet begins with background information, explained in lay terms, specific to the waste management option being presented. Each lesson is clearly outlined, with new vocabulary words, the learning concept being presented, motivational and enrichment activities, and references to appropriate worksheets and overhead visuals enclosed in the packet. The activities are structured to provide you with the flexibility to modify the lessons to the skill level of your students. You will also find a section listing organizations and additional teaching resources that are available on the topic of solid waste.

Student Worksheets

These four worksheets are reproducible on your school copy machine. Duplicate as many as you need for your students. These worksheets are enclosed to provide students with hands-on reinforcement for the educational concepts being taught, as well as to provide you with a useful and convenient evaluation tool to gauge the effectiveness of the teaching materials in conveying the educational concepts.

The four worksheets are:

Count Me In

This worksheet is a chart on which students record every item they throw out for an entire day. The chart provides columns for students to indicate the material category of the discarded item — paper, aluminum, glass, plastic, etc. This chart will be used for a classroom activity which involves characterizing, or profiling, the composition of the classroom's solid waste.

Making a Model

This worksheet provides instruction on how to build a classroom compost column which gives students an opportunity to experience nature's recycling first-hand. The compost column will simulate the conditions of a backyard compost system.

CAUTION: The construction of the compost column requires the use of sharp tools. Each teacher should consider the maturity and skill level of students in determining the amount of assistance and supervision required for the safe construction of the compost column.

Planet Patrol at Work

To be used in conjunction with the wall chart, this worksheet has students identify the various solid waste handling behaviors illustrated on the poster and categorize them by method, such as source reduction, recycling, composting, re-use, incineration and landfilling. Students will also identify behaviors which help the environment and products which are made from recycled material.

On Patrol for Solid Waste Solutions

This fun crossword puzzle will challenge students' knowledge of the solid waste issue, and will provide classroom teachers with an evaluation tool.

Parent Take-home

Because the issue of solid waste management is so important, it is appropriate for parents to understand what families can do at home and at work to help. The Parent Take-home is also designed to be reproduced on your school copy machine in classroom quantities. We request that you distribute these to students to bring home and share with their parents along with their worksheets.

Overhead Visuals

These graphs and charts visually explain the scope of the solid waste issue and the various methods for handling solid waste. The charts and graphs are referenced in the lesson guide. Photocopy onto an overhead acetate for use on your overhead projector or photocopy on plain paper and distribute as a visual reference for your class.

Evaluation Card

Procter & Gamble has been developing classroom support materials for many years. We value your experience as a classroom teacher, and we invite you to please take a few minutes of your valuable time to complete the evaluation card enclosed in this packet. We listen to what educators tell us, and we rely on that feedback to create materials based on your recommendations. By filling out and returning this card, you can be assured of remaining on our mailing list.

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Program Concepts and Educational Objectives

This unit is intended to convey to students an understanding of the methods of solid waste handling and disposal. They will learn about demonstrating responsible buying decisions, practicing resource and energy conservation, and supporting integrated solid waste management, especially source reduction, recycling and composting. These are gigantic steps toward solving our solid waste issues.

The multi-disciplinary lessons and activities in this environmental education unit were designed to enhance and reinforce students' skills in:

- vocabulary building
- oral and written communication
- research and data collection
- charting and graphing
- critical thinking
- organization
- problem-solving and cooperative learning
- citizenship

Audience

This classroom unit has been developed for use in grades four through six, with activities appropriate for science, language arts, math and social studies.

Acknowledgments and Special Contributors

For many years, the Procter & Gamble Company has been providing the educational community with curriculum support materials in the areas of Home Economics and Social Studies. These materials are carefully prepared by educators like you who know what works in the classroom. Procter & Gamble gratefully acknowledges the efforts of its Environmental Education Advisory Committee, who assisted in the development and review of these educational materials.

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Introduction

Everyday, each of us makes and has to deal with solid waste or trash. Almost every human activity makes trash.

In the United States, we generated about 196 million tons of trash in 1990. That's about 4.3 pounds per person per day. Recycling and composting are growing. After recycling and composting, we only discarded about 3.6 pounds per person per day. Incineration with energy recovery has grown as well. The use of landfills is being reduced.

While many landfills are being closed, these are usually the "dumps" where trash was left unattended with no environmental controls. New landfills are being developed to replace these old dumps and the new landfills have more volume and modern environmental controls.

What should we do with our solid waste in the U.S.? Scientists, government, industry and concerned citizens are examining the possibilities. We already know that the solutions will be neither simple nor easy. Indeed, research indicates that there is no single answer.

Each of us generates 1,600 pounds of garbage a year.

Instead, our solid waste solutions may lie in a plan such as that proposed by the Environmental Protection Agency, which involves an integrated approach to solid waste disposal. This four-point plan, originally proposed in 1976, advocates waste management options which include: 1) reducing the amount of waste produced, 2) recycling, reusing and composting, 3) waste-to-energy incineration, and 4) landfilling, as the most effective ways to manage our solid waste.

As one of the world's largest producers of packaged consumer goods, we recognize our responsibility to do our part. We believe that designing every P&G product with an eye toward consumer satisfaction and environmental responsibility is consistent with improving the quality of life.

We encourage you to share the information in this classroom unit about solid waste management solutions with your colleagues, your students and their parents. Working together, we all can make a world of difference.

First of all, what is **solid waste?** Solid waste, commonly known as trash or garbage, is everything that is thrown away by households, business, industry and institutions. Soda cans, food, milk jugs, broken toys, fast-food packaging, school papers, newspapers and paper plates, frozen dinner trays, grass clippings, worn out tires, an old sweater...you name it.

Altogether, we generate nearly 196 million tons of solid waste each year in the U.S. When you throw something away, have you ever wondered where "away" is? For 67 percent of our garbage, "away" is a sanitary landfill. About 17 percent of our waste is recycled, and the remaining 16 percent is incinerated. (Refer to Graph #3.)

First Law of Garbage: Everybody wants us to pick it up, and nobody wants us to put it down.

— from Characterization of Municipal Solid Waste, 1991 Franklin Associates

As you can see from Graph #1, the materials that make up our solid waste stream include paper, yard trimmings, metal, glass, food and plastics. When measuring the composition of municipal solid waste (MSW), it is important to consider both the weight and the volume. (Graphs #1 and 2.) In determining landfill capacity, volume is ultimately of greater importance. Landfills do not close because they are overweight, but because they have reached their volume capacity. The most current scientific evaluation of MSW on the basis of volume is reflected in Graph #2.

In this unit, students will learn about the various materials which make up our solid waste stream and the waste handling options recommended by the EPA.

The EPA's Approach to Waste Management

The EPA has set an agenda for using an integrated waste management system that implements a holistic approach involving:

Source Reduction, to decrease the total volume of waste;

Recycling and composting, to reuse a major portion of waste to further reduce waste going to landfills and incinerators;

Waste combustion, to reduce the bulk of municipal waste, thus conserving valuable landfill capacity, with the added benefit of energy recovery; and

Sanitary landfilling, for those materials which cannot be recycled, composted or safely incinerated and for combustion ash (the matter that's left after incineration).

Local environmental, economic and institutional needs will play a major role in determining the waste management mix that will work best for each community.

Our Natural Resources Today

In the two centuries that our country has grown and expanded, politicians, businessmen, industrialists, and even citizens like you and me, have thought of our lakes and rivers and our plentiful land and mineral resources as the building blocks of America. A concentration on the source reduction, recycling and composting options of integrated waste management can help conserve our natural resources.

Solid Waste Legislation

Historically, the handling of municipal solid waste (MSW) has been the responsibility of local governments. The mid-1960s saw the first action by the federal government to take a more active role in providing guidelines which would assist state and municipal governments in handling their solid waste.

Legislation has included the Solid Waste Disposal Act (1965), the Resource Recovery Act (1970), and the Resource Conservation and Recovery Act (RCRA) (1976). The RCRA deals with the regulation of hazardous waste, the elimination of open dumping, promotion of solid waste management programs and the furthering of solid waste management options in rural communities. These federal laws affect standards for landfilling, waste-to-energy ash management and sanitary landfilling.

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Within the area of solid waste management, government can be most effective in providing positive industry and consumer incentives such as tax credits; in supporting the development of recycling and composting technologies and markets; in siting and funding incineration facilities; and in encouraging communities to adopt plans that will responsibly address 100 percent of their solid waste. Finally, government can offer technical assistance, education, and research and development, which are key to the informed participation of cities and citizens in any integrated waste management plan.

Industry's Role

Industry can:

- pursue opportunities for source reduction;
- use and make products and packages that are recyclable;
- make products compostable if recycling is not feasible;
- maximize the use of recycled materials (e.g., plastics, aluminum, paper, etc.)
- ensure products/packages are compatible with waste management systems.

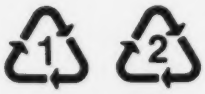
Futhermore, industry can continue working to identify and develop new markets for composted and recycled materials while cooperating with government to form the needed infrastructures for these systems.

Industry can also play an important role in educating consumers about the environmental advantages of certain products and packages. Communications must be accurate and technically supportable.

Consumer's Role

Each of us has a very important and influential role to play in resolving the solid waste issue. Did you know that if you shared your feelings and knowledge about this environmental issue with two people one day, and those two each shared it with two more on the second day, and those four with two more each, and on down the line, that within just *one month*, everybody in the whole country could be doing something about solid waste?

What can one person do? Lots of things! Look for packaging which contains recycled material and can be recycled. When shopping, look for plastic packages which carry the Society of the Plastics Industry resin code. This symbol indicates the type of plastic the package is made from, so the plastic can be sorted by type to facilitate recycling. Buy foods in large sizes. Leave grass clippings on the lawn. Eliminate household toxic materials from the waste stream by supporting and using collection sites for hazardous household wastes like batteries, pesticides, paint and solvents. If your community does not have a recycling program, help start one.



Write letters to manufacturers asking them to make environmentally responsible products and packaging. Write to your local government officials asking that recycling and composting programs be implemented, and that collection centers for hazardous household waste be initiated.

Don't just get involved, *stay* involved.

What Procter & Gamble is Doing About Responsible Solid Waste Solutions

Since our founding in 1837, Procter & Gamble has been committed to providing products of superior quality and value that best fill the needs of the world's consumers. In doing this, we are seeking ways to support integrated waste management. Some of the steps we are taking include:

Source Reduction

- reducing the volume and weight of products and packaging
- developing concentrated products which require smaller packages
- using less raw material and reducing waste at our manufacturing plants

Recycling and Composting

- using recycled and recyclable materials whenever possible
- using the Society of the Plastics Industry resin code on our plastic bottle packaging
- encouraging consumer recycling
- undertaking major efforts to encourage the development of the necessary infrastructure to support recycling and composting
- removing heavy metals (e.g., lead and cadmium) from our packaging that can contaminate the compost

Incineration

- removing heavy metals that can concentrate in incinerator ash
- insuring our products and packages are safe when incinerated

Landfill

- developing compactable products that take up less landfill space
- insuring our products/packages are safe when landfilled

Introducing the Solid Waste Issue to the Class

After reading all the background information provided above and at the beginning of each of the four lessons in this guide, you should have a good grasp of the solid waste issue. While there is no denying it is a complex, multi-faceted issue, it is nonetheless one that is critical for even the youngest consumers to understand.

As a basis for evaluating students' prior knowledge, before beginning the unit, ask students:

1. What is solid waste, or garbage?
2. What kinds of things make up garbage?
3. Where does garbage come from?
4. Where does garbage go when we throw it away?
5. What can each of us do to reduce the amount of garbage we create every day?

When you have completed the entire unit, repeat these questions to your students and see how their knowledge and attitudes about garbage may have changed.

If you have been teaching environmental education, your students may already be aware of the various handling options for solid waste, such as recycling, incineration and sanitary landfilling. What they may not be aware of is how these and other waste handling options such as source reduction and composting should be integrated to work together in a comprehensive plan.

Using Graphs #1, #2 and #3, explain to students the composition of municipal solid waste (MSW) and how America is currently handling its waste. Use Graph #3 to demonstrate how we must re-order our waste handling priorities over the next few years to conserve landfill capacity.

Procter & Gamble's expanded use of recycled plastic in its consumer products bottles will keep 100 million gallon sized milk and water bottles and 15 million 2-liter soft drink plastic bottles out of our nation's landfills.

Lesson 1 Sanitary Landfills

Concepts

1. Sanitary landfill capacity is now harder to site for political reasons. Geologically, it is easier.
2. Modern sanitary landfills are being designed, constructed and run safely.
3. We will probably always need sanitary landfills to manage some part of our solid waste.

Vocabulary

Biodegradable — capable of being broken down by bacteria and other organisms into basic elements. Most organic waste, such as food and paper, is biodegradable.

Leachate — a liquid resulting from rainwater and melted snow percolating through landfills containing water, bacteria and decomposed waste.

Municipal Solid Waste (MSW) — what we refer to as trash or garbage, composed of paper, plastic, metal, glass, food, yard clippings and other miscellaneous materials.

NIMBY — "*n*ot *i*n *m*y *b*ackyard," a term used to characterize the public's attitude about landfills and incinerators, meaning that they do not wish one of these facilities to be located near their homes or neighborhoods.

Organic — of plant or animal origin.

Photodegradable — a process, particularly in plastics, whereby the sun's ultraviolet rays attack the connections, or links, in a plastic (polymer) chain causing the plastic to fall apart. Photodegradation does not occur in landfills as no light is present.

Sanitary Landfill — a refuse disposal method for the safe, permanent storage of garbage, having daily coverage of waste with soil, leachate collection systems, methane gas controls and environmental monitoring systems.

Materials

Solid Waste Charts and Graphs
Student Worksheet, "Count Me In"
Two cardboard boxes, one double the capacity of the other
Measured amounts of waste paper, aluminum, plastic or other material
Scale for weighing the filled boxes

What's the Issue?

Currently, about 67% of our solid waste is being landfilled. The long-term goal set by the EPA is to reduce the amount of garbage we landfill to only 15 percent. This goal is attainable only if the other options of source reduction, recycling, composting and incineration are fully developed.

By the mid 1990's, about half our current 6,000 municipal solid waste landfills will be closed. Many of these are the small "dumps" which were simply convenient places to bury our trash. While the NIMBY syndrome has made it difficult to site new landfills, many forward looking communities have designed, sited and are now operating new landfills. These modern facilities replace the capacity lost from closure of the "dumps".

Technologies exist to ensure environmentally safe site selection, design, operation and closure of landfills. They are equipped with liners to prevent ground water contamination, leachate monitoring and detection systems, and methane gas controls.

In the future, landfills will remain an essential part of comprehensive solid waste management, particularly for nonrecyclables and for the safe disposal of incineration ash.

Simply stated, a sanitary landfill is a place where we bury our garbage. Site suitability for a sanitary landfill is determined only after a potential site has passed stringent legal, environmental and engineering criteria. Careful analysis of surface and subsurface geology, hydrology (water), the nature of adjacent environments, access routes and proximity to waste generation sources is required.

Through careful engineering, a network of drains is designed to retain, collect and then treat all the snow or rainwater which percolates through the landfill before it is finally released.

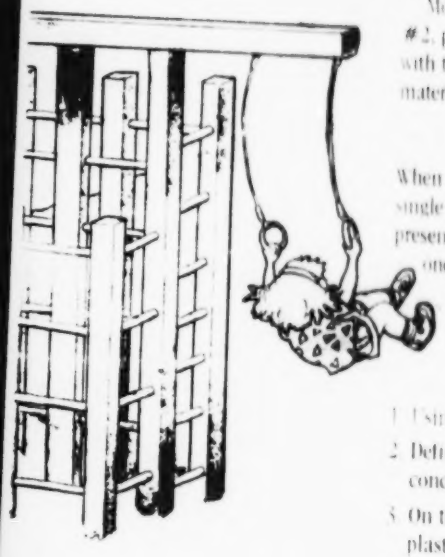
Landfills are divided into small areas called "cells." These smaller cells minimize the landfill's exposure to wind and rain. Each day, after the waste has been delivered to the site and has been compacted as much as possible, it is covered over with earth or other material to minimize odor and prevent insect and vermin problems.

As each cell becomes full, it is capped off and sealed with a layer of clay and earth and is seeded with grass according to an approved closure plan.

What Goes Into a Sanitary Landfill?

Of the 196 million tons of garbage we throw away, nearly 70 percent of it is paper, leaves, grass clippings and food wastes. Technically speaking, all of this is organic, and therefore biodegradable. However, in a landfill it doesn't make much difference whether or not material is biodegradable. Dr. William Rathje, a professor of archeology at the University of Arizona who calls himself a "garbologist," has learned through his studies of landfilled garbage that little, if any, degradation occurs in a landfill. From hot dogs to the Sunday newspaper, Dr. Rathje's work has proved that landfills are entombing and preserving much of our garbage.

Most of the remaining 30 percent of our garbage is glass, metal or plastic. As you can see from Graphs #1 and #2, plastics make up about 8 percent of the waste stream by weight and about 21 percent by volume. Contrast this with the volume of paper, which is 32%, and metal which is 11% (about half the volume of plastic). Some of these materials are perfectly suited to recycling or composting.



When people have a problem, they will often look for a simple solution. In the instance of solid waste, there is no single solution. Instead, many smaller solutions have to work together. Sometimes what seems like a good solution presents other problems. We have already learned about some of the problems relating to landfills. Nobody wants one in his backyard because of perceived environmental concerns. What goes into our landfills will be with us for a long time. Let's think very carefully about how much we can keep OUT of the landfill.

1. Using the background information, introduce the concepts and related vocabulary to students.
2. Define for students the difference between organic and inorganic waste. Test students' understanding of this concept by listing examples on the board from student responses.
3. On the board, form column headings for each of the seven MSW materials categories: paper, metals, plastic, yard waste, food waste, glass, and rubber, leather, textiles. Divide the class into seven teams and have each team list as many items for its category as they can think of.
4. Refer students to Graph #1, Composition of MSW by Weight. Have some math fun by asking students to calculate the weight of each of the seven categories of solid waste, based on a total weight of 196 million tons.
5. Photocopy and distribute to students the worksheet, "Count Me In." This worksheet will require students to list EVERY item they throw away for a full day and to categorize the material by type. (Students may need more than one sheet.) When the worksheets are completed, students will use the information for an exercise in Lesson 2.

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Lesson 2 *Source Reduction:* Priority 1

Concept

Source Reduction means making less garbage.

Vocabulary

Efficient — using the most effective and least wasteful means of accomplishing a task.
Lifestyle — ways of living, daily habits which affect the environment.
Reduce — to make or use less of something.
Reuse — to use again.
Repair — to fix or mend.

Materials

Student worksheet, "Count Me In"

What's the Issue?

Source reduction involves products, packaging, manufacturing processes and ways of living which minimize the amount of waste created. By reducing the amount of garbage we create, we will also be reducing the amount of solid waste that must be incinerated or landfilled.

Within the solid waste stream, there are four main categories of refuse (refer to Graph #4):

- **durable goods**, which include furniture, large appliances, tires, etc.;
- **non-durable goods**, which include paper products, clothing, and small plastic products;
- **containers and packaging**, which include cans, bottles, boxes and wrapping material; and
- **other wastes**, which include food and yard wastes and inorganic wastes.

As you can see, containers and packaging are a significant portion of the waste stream — more than 30 percent. It would be easy to point the finger at packaging as a key source of unnecessary waste. However, while there are certainly areas in which packaging can be reduced or even eliminated, there are a number of reasons why packaging is necessary and beneficial:

- Packaging keeps products sanitary.
- It reduces food waste by keeping products fresh. A study by the University of Arizona found that consumers in Mexico City, where little packaged food is consumed, throw away 40 percent more solid waste than U.S. households, mostly food debris.
- Packaging carries necessary usage directions, cautions and warnings.
- Tamper-resistant and child-resistant packaging helps protect consumers.
- Packaging protects the product during shipping and shelf display.

How Is Source Reduction Being Accomplished?

The good news about containers and packaging is that their percentage in the waste stream has actually been declining since 1970. This reduction is due in part to the efforts of consumer products manufacturers, such as Procter & Gamble.

At Procter & Gamble, we are addressing source reduction in three major ways:

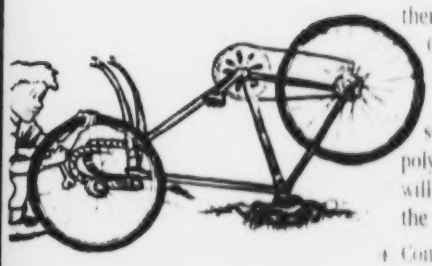
1. designing products and packaging that create less waste;
2. minimizing waste in manufacturing; and
3. encouraging our suppliers to help us come up with more waste saving ideas.

The first recorded use of packaging occurred in 1551 when a German papermaker began placing his paper in a wrapper with his maker's mark.

When Procter & Gamble designs products or packaging, we use the most efficient materials. For example, we use plastic rather than glass for bottles because it is lighter weight and shatterproof. If not recycled, it burns to release useful energy when incinerated and its ease of compaction means it takes up less space in a landfill. We are making multifunction products, such as Tide detergent with a bleach additive and Pert Plus which combines shampoo and conditioner which eliminates the need for a separate package purchase. We offer larger product sizes to reduce packaging waste, and refillable containers, long popular in Europe, are now available in the U.S., too. New ultra concentrated formulas for liquid detergents reduce the amount of packaging needed, thereby helping reduce solid waste. The 50 ounce ultra liquid bottle uses 20 percent less plastic than the 64 ounce bottle it replaces. With the refill system, consumers can reuse the original detergent bottle by purchasing a separate refill package. And, the refill is made with 40 percent less packaging. Wherever possible, we use the least amount of packaging necessary to protect both the consumer and the product. New technology has eliminated outside cartons for Sure and Secret deodorants saving 3.4 million pounds of solid waste each year.

Classroom Activities

1. Introduce the concept of source reduction and the related vocabulary.
2. There are many things that companies like Procter & Gamble are doing to reduce the amount of waste being produced. Solicit suggestions from the class on things they can do every day that will help in the area of source reduction. Have each student write and illustrate his suggestion and compile it into a source reduction booklet, or make a class bulletin board. Some possibilities: use both sides of your school paper; try to fix or repair a toy or article of clothing or donate it to charity rather than throw it away; bring your own bags to the grocery store; request that your name be removed from "junk mail" lists; when you buy a good book, share it with a friend; return extra hangers to the dry cleaner for reuse; leave grass clippings on the yard instead of bagging them up for the landfill.
3. Archeologists and anthropologists have learned a lot about ancient cultures and civilizations by studying their debris, or garbage. Divide the class into seven teams, one for each of the seven categories of waste. (Collect the class "Count Me In" worksheets beforehand, and make seven complete sets, one for each team.) Using the data they've collected on their worksheets, "Count Me In," each team will tabulate, analyze and draw conclusions about its assigned waste category. For example, the "Plastics Patrol" may subdivide its category and tabulate how many milk jugs, soda bottles, six-pack rings, fast-food clamshells, polystyrene lunch trays, eating utensils, etc., were tossed away in just one day by the class. "Patrol" leaders will work together to analyze and draw conclusions about what materials are the greatest contributors to the waste stream and which areas could most easily be reduced.
4. Compare the class' trash profile with Graph #1.



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Enrichment Activities

1. After taking an analytic look at themselves, your "Planet Patrol" will have a trained eye for spotting waste. Have students conduct a source reduction audit in your school to see where the greatest amount of waste is occuring. Assign teams to observe and evaluate the various areas: cafeteria; administration offices; building maintenance; classrooms; playground; even the teachers' lounge. Work with students to develop evaluation criteria which include categorizing the type of waste and wasteful behaviors they observe. Have students make specific written suggestions on ways to reduce the amount of waste being generated. Present the suggestions to your principal and write an article about the class' research for the school paper; write a letter to the cafeteria manager or custodian suggesting changes or alternatives.
2. Write skits to get the message to others and perform them for a school assembly or parents' night.

Lesson 3 — *Recycle and Compost:* Priority 2

Concepts

1. Recycling and composting are waste management methods that conserve natural resources, save energy and reduce the strain on incinerators and landfills.
2. A significant portion of all our garbage can be handled using either recycling or composting.
3. Recycling and composting.

Vocabulary

Composting — the controlled biological decomposition of organic solid waste materials by micro-organisms under aerobic (in the presence of oxygen) conditions. Composting keeps garbage out of the landfill and produces useful soil amendments called humus or mulch for landscaping.

Conserve — to use wisely, and as little as possible.

Natural Resources — include land, water, air and minerals. There are two types of resources: renewable, meaning we can make or grow more; and non-renewable, meaning that when we have used it all up, there will be no more.

Reclaimable — able to be recycled. Reclaimable materials include paper and other wood products, glass, most metals and all types of plastics.

Recycle — a resource recovery method involving the collection and treatment of a particular waste product so it can be used again to make a new product.

Materials

Poster board, markers, paint, glue
"Making a Model" Diagram and Instructions

Every recycled aluminum can saves 6 ounces of oil.

What's the Issue?

Recycling

Recycling is a technology that involves four very important steps: collection, separation, processing of new products, and developing end-use markets for those new products. Separation and collection alone do not make a recycling program. This process is not completed until a material is processed, purchased by consumers and used again. Also, consumers need to read labels and buy products packaged in recycled materials.

60 billion aluminum cans were recycled in 1992.

Today, we are recycling about 17 percent of our solid waste. At present, recycling systems vary widely by material and geography. Much of the material in the waste stream is recyclable: aluminum, steel, glass, plastic and paper. In the U.S., aluminum has achieved a greater than 60 percent recycling rate because of its ease in separation and collection and economic incentives to both can makers and consumers. Paper recycling is also well developed: Procter & Gamble Corporate Buildings in Cincinnati collects more than one million pounds of office paper and aluminum cans each year.

Consumer choices can help support recycling applications by:

- Reading labels and buying packages with recycled content
- Recycling only those items your community asks for
- Preparing bottles, cans, etc. so collection crew can get more into each truck

Great strides have been made in plastics recycling and vigorous efforts are underway to develop systems and markets for this virtually 100 percent recyclable material.

Composting is a special type of recycling, whereby organic wastes are converted to a rich humus or mulch by natural decay. Commercial and municipal composting systems were virtually nonexistent a few years ago, however, a host of factors are making composting an attractive waste management option:

- the environmental compatibility of a composting system,
- the low maintenance and operating costs,
- the revenue potential from selling the compost product, and
- public resistance to incineration/landfill.

Today there are over 20 municipal solid waste composting facilities and several pilot programs operating in the U.S. While these larger systems are a bit more complicated than your backyard compost pile, the basic concept of organic decomposition is the same. By maintaining temperatures greater than 131 degrees Fahrenheit, this municipally-composted material, consisting of food and yard wastes, paper and other miscellaneous organic waste, remains free of dangerous bacteria, and is carefully tested to ensure it meets all regulatory requirements.

Referring again to Graph #1, you can see that paper and paper board make up 37.5 percent of our garbage, yard trimmings nearly 18 percent and food waste nearly 7 percent. Over 60 percent of our garbage that could be composted instead of landfilled! Included among compostable material is the absorbent fiber of disposable diapers. Disposable diapers make up less than 2 percent of all our solid waste.

The people of St. Cloud, Minnesota, have been composting their garbage for about four years. Procter & Gamble has been helping them demonstrate that components of disposable diapers can be composted with other municipal solid waste to produce humus, a useful material for the agricultural and landscaping industries.

There is a long way to go in increasing the number of composting systems, but there is no doubt that composting can play a big part in U.S. recycling efforts. After source reduction, recycling and composting are good ways to handle our garbage in the future.

Classroom Activities

1. Introduce the concepts of recycling and composting, along with the related vocabulary.
2. To teach students to identify which materials are suited for recycling versus composting, it is important that they understand the difference between organic and inorganic materials. Have students bring to class actual items or photos of both organic and inorganic items. Students can create three-dimensional collages of "Organically Yours" and "Inorganically Yours" for posters or bulletin board displays. Don't forget to have students identify the plant or animal origin of each organic item. Ask them to indicate with a symbol or letter code whether the item is best for composting or for recycling.
3. "Pointers from the Planet Patrol." This activity allows each child to share a recycling tip with other students and families. The idea may be a recycling activity that the family is currently doing, or it may be an original idea that helps a family set a recycling goal. Collect the "pointers" and compile them into a format that can be photocopied and sent home with each child. You might also request that one "Pointer from the Planet Patrol" be included in each issue of the school's newsletter. Follow up at the end of the term to survey how many of the "pointers" families have begun practicing.
4. "Planet Patrol Scavenger Hunt, Craft Show and Art Exhibit." This fun activity will challenge imaginations and get family members involved in understanding the concepts of recycling and reuse. Ask students to create an item from discarded materials, and then enter it for judging in a classroom or schoolwide competition. Conduct a classroom brainstorming session which will encourage students to begin thinking about unconventional uses for discarded items.

   You may wish to set up the activity so students can enter under a particular category. For example, under the "Scavenger Hunt" category, entries may be judged on how cleverly the original materials have been disguised. Under "Crafts," the item may be functional, such as a pencil holder, or under "Art" it may be judged purely on its aesthetic appeal, such as a piece of sculpture. Ask your media center director about displaying the entries there, or consider coordinating the display with your school's Parent Night or National Recycling Month in April.

Extension Activities

1. "Planet Patrol In Action." Civic responsibility and environmental awareness are important concepts for children to learn and demonstrate at an early age. Consider contacting your local solid waste director, environmental office, or recycling coordinator and invite them to come and speak to the class about recycling efforts in your community. If there are none, have the class write letters to your local governing body (mayor, city council, county commissioners) asking that they be established.
2. Follow up by having the class organize a recycling effort in school, perhaps focusing on the the material they determined to be the biggest "offender" in their "Count Me In" exercise or Source Reduction Audit.
3. Consider a class trip to your local landfill.
4. Divide the class into pairs to construct models of a compost system to observe the decomposing activity which takes place. Follow the diagram and instructions provided on the blackline master, "Making a Model" which simulates the conditions in a backyard compost bin.
5. Make posters encouraging recycling and composting.

Concepts

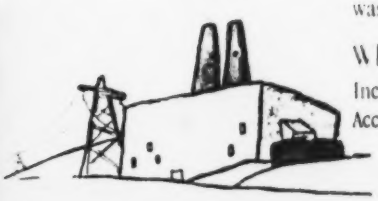
1. Waste-to-energy incineration is a way of handling garbage that reduces its volume and saves landfill space.
2. Waste-to-energy incineration turns garbage into electricity.
3. Waste-to-energy incineration works most effectively and safely in cooperation with recycling programs.

Vocabulary

Air Emissions — the products of incineration such as carbon dioxide and other gases that are released from combustion facilities.
Ash — what is left over after any material is burned.
Combustion — burning.
Incinerate — to burn at very high temperatures.
Waste-to-Energy (WTE) Incinerator — a facility using high temperature burning of waste to generate energy.

Materials

Rolled up newspaper, weight scale (grams up to one kilogram), ruler for measuring dimension, metal wastebasket, long fireplace matches or lighter, two oven mitts, fire extinguisher



What's the Issue?

Incineration reduces the volume of solid waste by about 90 percent and its weight by about 60-70 percent. According to the EPA, there are currently about 175 waste combustion facilities operating in the U.S., with 135 of them recovering energy. Together, they process about 16 percent of our solid waste. New facilities are under construction, so that more and more of our solid waste will be processed in these facilities.

When garbage is burned, it produces ash and air emissions. Ash from incinerators is regularly tested for the presence of heavy metals such as cadmium, lead and mercury, as well as hazardous organic materials such as dioxin and furan. Ash from incinerators is placed in specially designated landfills. Like ash from power plants, incinerator ash is also being used as a construction material in recycled pavement and as a concrete additive.

Many states have established emission standards for waste combustion. Many of the same pollution control technologies which are required by law for use in coal-fired power plants are also being successfully applied to waste combustion facilities. Studies have shown that these pollution control devices can effectively remove up to 99 percent of any harmful molecules that might survive the burning process.

Classroom Activities

1. Introduce the concepts and related vocabulary.
2. Demonstrate to the class the effect of incineration on material weight and volume. This demonstration is best conducted out of doors by the teacher. Students can help. First, have students weigh and determine the approximate volume of the rolled-up newspaper. Take the class and the materials for the demonstration outside. Place the newspaper in the waste basket. Ignite the newspaper and allow it to burn to ash. **Allow the waste basket to cool completely.** Using oven mitts (in case the waste basket is still warm), return the waste basket to the classroom. Remove the ashes and place them in a container whose capacity and weight have been predetermined. Have students calculate the weight of the *ashes only* and determine their approximate volume. Compare your results with the percentage reductions discussed in the background information at the beginning of this lesson.

3. If your community has a waste-to-energy incinerator, consider arranging a field trip. Prepare a list of questions beforehand to ask the tour guide. Questions might include: How much garbage is burned each day? What is the most common material burned? Does the facility work together with a recycling program to screen the type of material that ultimately gets burned? How much electricity do you generate?
4. As discussed above, the air pollution controls on incinerators and coal-fired electric power plants use very similar technology, and some of the ash management and resource recovery programs are also similar. Many local utility companies maintain active community education programs and speakers' bureaus. Contact your local utility for more information and invite a representative to come to your class to explain the pollution control technologies and various ash management plans they use.

Student Evaluation

At the conclusion of the unit, use "Planet Patrol At Work" with the wall poster and the "On Patrol for Solid Waste Solutions" crossword puzzle as further evaluation tools to measure students' understanding of the concepts presented in the unit.

Additional Resources

For more information on solid waste management or other free or low-cost environmental education classroom materials, call or write:

Alliance for Environmental Education
51 Main Street
P.O. Box 368
The Plains, VA 22171
(703) 253-5812
(703) 253-5811 (fax)

Bottle Biology Resources Network
University of Wisconsin
1630 Linden Drive
Madison, WI 53705
(608) 263-5645

American Plastics Council
1275 "K" Street, N.W., Suite 400
Washington, D.C. 20005
(202) 371-5319
(800) 2-HELP-90

Keep America Beautiful
Mill River Plaza
9 West Broad Street
Stamford, CT 06902
(203) 323-8987

North American Association of Environmental Education
Suite 400
1255 23rd Street N.W.
Washington, D.C. 20037
(202) 467-8754
(202) 862-1947 (fax)

National Association for Plastic Container Recovery
5770 NationsBank Corporate Center
100 N. Tryon Street
Charlotte, NC 28202
(704) 358-8882

National Gardening Association
180 Flynn Avenue
Burlington, VT 05401
(802) 863-1308

National Geographic Kids Network
Educational Media Division
National Geographic Society
17th and "M" Streets
Washington, D.C. 20036
(202) 775-6580

Polystyrene Packaging Council
1025 Connecticut Avenue, N.W., Suite 515
Washington, D.C. 20036
(202) 822-6424

Public Television Outreach Alliance
"SAVE IT!" Campaign, $2.00 booklet
2611 Shirlington Road
Arlington, VA 22206
(703) 979-8473

Smithsonian Institution
"A Better World Starts at Home," free poster
Office of Environmental Awareness
Washington, D.C. 20560

U.S. Environmental Protection Agency
Office of Community and Intergovernmental Relations
Mail Code A-108EA
401 "M" Street, S.W.
Washington, D.C. 20460
(202) 382-4454

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PLANET PATROL

Count Me In

Did you know that each of us throws away about 4 pounds of trash every day? This worksheet will help us to understand what we can do about it.

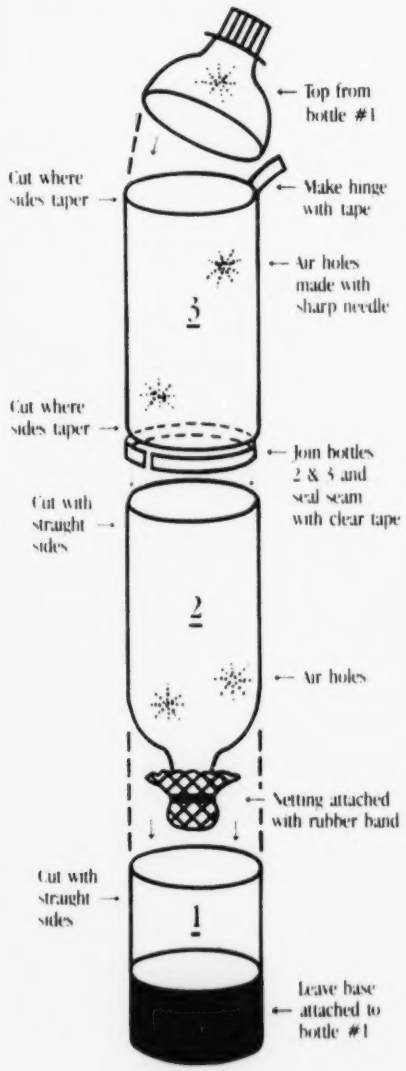
INSTRUCTIONS: Carry this worksheet with you for one entire day, from the time you wake up until you go to bed. Every time you throw something away, write down the name of the item. Also, put a check mark in the column that says what kind of material it is made of.

ITEM	PAPER	YARD	FOOD	PLASTIC	METAL	GLASS	RUBBER LEATHER TEXTILES

PLANET PATROL

Making A Model

Procter & Gamble Educational Services


Top from bottle #1
Cut where sides taper
Make hinge with tape
Air holes made with sharp needle
3
Cut where sides taper
Join bottles 2 & 3 and seal seam with clear tape
Cut with straight sides
2
Air holes
Netting attached with rubber band
Cut with straight sides
1
Leave base attached to bottle #1

Composting is based on the biological process of decomposition. What turns plants and animals into compost? Microscopic bacteria and fungi, which feed on dead tissue, are the important organisms.

What affects the composting process? The amount of moisture and air, temperature, amount of bacteria and fungi, and the nature of the decomposing material are all critical. The presence or absence of air (oxygen) is one of the most important factors in composting. The practice of composting allows air and moisture to speed the natural process of biodegradation. In a backyard composting system, it is customary to run a pole or stick through the compost heap regularly or to turn the material with a shovel to allow air circulation.

Making a compost column lets you see and experiment with this process, and witness nature's world of recycling.

Materials Needed

1. Three 2-liter plastic beverage bottles.
2. Hot tap water, knife, scissors, marking pen, needles or paper clips for poking holes, candle, clear tape, netting or mesh fabric, rubber bands.
3. Organic materials for composting, such as vegetable or fruit kitchen scraps, leaves, newspapers and grass clippings.

Procedure

Remove the bases from two bottles, and the labels from all three, by pouring about two cups of hot tap water into the bottles. (Columns can also be made from bottles that don't have removable bases.) Replace the cap, tilt the bottle so the water softens the heat-sensitive glue, peel off the label and twist off the base. Pour out the water and draw cutting lines around the bottle. Your teacher will help you make incisions with the knife and to cut and assemble the column as illustrated.

Most columns will require air holes for ventilation. These can be poked into the plastic with a sharp needle or paper clip that has been heated in the candle flame under your teacher's supervision. Alternatively, larger holes can be cut into the sides with the knife and covered with fine mesh fabric held in place with tape. **Be sure to use extreme care in using sharp instruments.** A piece of mesh fabric over the lower end allows for drainage. Refer to the illustration. Add ingredients for composting through the top of the column.

Explorations

The possibilities for compost column explorations and discoveries are endless. There is no limit to what can be put inside, or the conditions under which the column can be kept. In addition to simply observing changes, you can design experiments which explore the effects of variables on your column. On the back of this sheet are two ideas:

May be reproduced

- **Newspaper Digester.** Make two columns, and use a balance or postal scale to weigh out two equal quantities of newspaper (about ½ pound will do). Shred or cut the paper into strips and loosely pack one column with paper only. Mix about a half cup of garden soil to the other batch of paper and loosely pack the second column. Pour equal amounts of pond or rainwater into each column, and wait several hours for it to seep through. If none comes out the bottom, add more in equal amounts until about a half cup drips into the reservoir. Schedule a rainstorm to occur in the column every few days, pouring the drippings back through the column. Which column decomposes faster and why?

- **Compost Tea.** Compost columns can be used to generate a liquid fertilizer called "compost tea." Try making several columns using different ingredients whose drippings will differ in color and chemistry. Use this liquid to water and fertilize identical sets of seedlings to see how different brands of "tea" affect plant growth.

Adapted from the *Bottle Biology Resources Network*. University of Wisconsin-Madison, 1630 Linden Dr., Madison, WI 53706, (608) 263-5645.
Used with permission.

Contact the Bottle Biology office for help with questions or for information about other activities.

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Planet Patrol at Work

In this unit we have learned a lot about the four methods we use to handle solid waste and about the new products that can be made from recycled material. The Planet Patrol poster shows examples of these methods and products. See how many you can spot and list them in the right category of this worksheet. Also look for and list examples of things people are doing to conserve energy and help the environment.

SOURCE REDUCTION

RECYCLING AND COMPOSTING

INCINERATION

LANDFILLING

HELPING THE ENVIRONMENT

MADE FROM RECYCLED MATERIAL
(Look for the recycling symbol)

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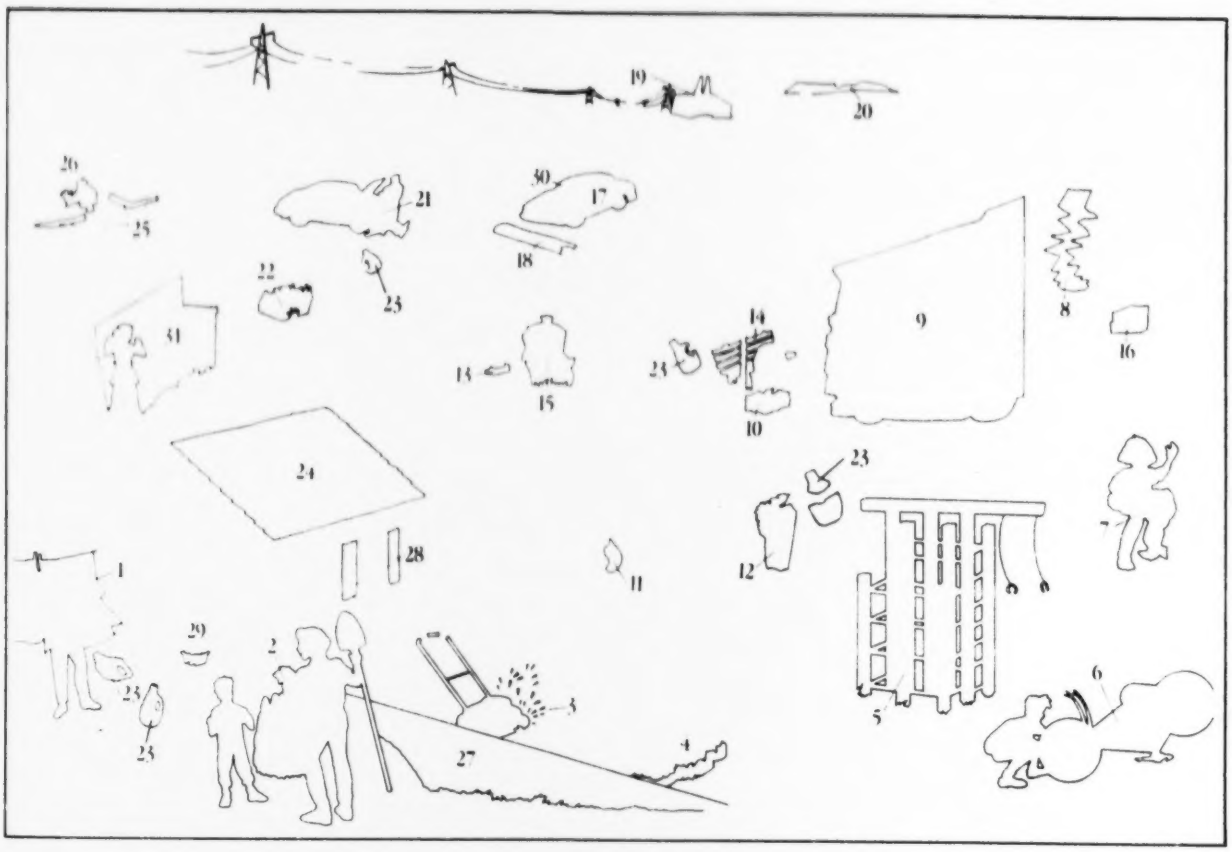

Source Reduction

3 — Leave grass clippings on yard
4 — Reusing old tires for planters
6 — Repairing bike
7 — Mending clothing
21 — Proper disposal of batteries and oil
11 & 12 — Reusable cloth shopping bags

Recycling

2 — Composting
8 — High quality office paper
10 — Newspapers
13 — Plastic bottles
15 — Aluminum and plastic
22 — Glass bottles
31 — Neighborhood recycling center

Incineration

19 — Waste-to-energy generates electricity

Landfilling

20 — One of the four solid waste solutions

Helping the Environment

1 — Using clothes line instead of dryer
26 — Planting trees and shrubs
17 — Carpooling
9 — Using public transportation
2 — Composting
13 — Smashing soda bottles and cans (makes more room in the Recyclaimer bin)
30 — Open windows in car instead of using air conditioning

Made From Recycled Material

16 — In/Out baskets in office
14 — Park benches
5 — Playground equipment
23 — Downy and Tide bottles
27 — Fencing
25 — Edging logs
28 — Window shutters
29 — Flower pots
18 — Speed bumps
24 — Roofing shingles

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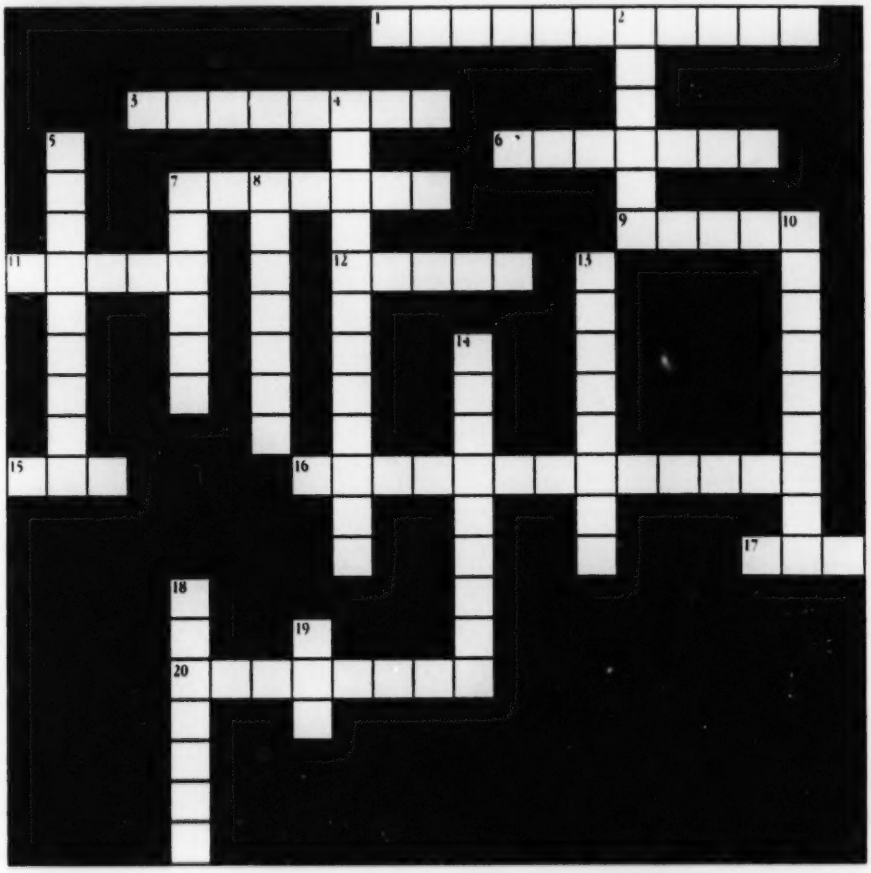
PLANET PATROL

On Patrol For Solid Waste Solutions



ACROSS

1. A place where garbage is burned.
3. A place where we bury our garbage.
6. Of plant or animal origin.
7. What we do with paper, plastic, aluminum and glass to save energy and make new products.
9. A form of source reduction that means using a product more than one time.
11. Municipal _____ waste.
12. An attitude that means people don't want to live near a certain kind of facility, whether it is a landfill, a recycling center or a waste-to-energy plant.
15. A way to spell garbage with three consonants.
16. Can be broken down by bacteria when oxygen and moisture are present.
17. Three letters for waste-to-energy.
20. To use wisely, and as little as possible.

DOWN

2. To fix or mend.
4. Burning at very high temperatures.
5. Recycling saves energy and natural _____.
7. To make or use less of something.
8. A mixture of decayed organic matter.
10. Using the most effective and least wasteful means of accomplishing a task.
13. Liquid that can come from a landfill.
14. Ways of doing things, daily habits.
18. What an item comes wrapped in to protect it.
19. What is left over when garbage is burned.

Procter & Gamble Educational Services

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PLANET PATROL

What Your Family Can Do With Trash

Procter & Gamble is a leader among corporations concerned about protecting the environment and creating a safer, cleaner world for future generations. We view every P&G product with an eye toward ensuring that the manufacturing and disposal processes are as safe and technologically advanced as they can be.

This week, your child joined the kids of the Procter & Gamble Planet Patrol to learn about responsible ways to handle our trash. Scientists, environmentalists, politicians and business leaders have been working together to find responsible solutions for handling our trash — what the experts call *solid waste*.

Procter & Gamble recognizes that the management of solid waste is a growing concern in communities across the country. We firmly endorse the integrated approach to solid waste management advocated by the United States Environmental Protection Agency (EPA).

This plan recommends four effective ways of dealing with solid waste, listed here:

1 Source Reduction

This simply means making a national and personal commitment to reduce the amount of material that enters the disposal and landfill system.

3 Waste-to-Energy Incineration

This process provides communities with an independent source of energy by converting waste which can be safely incinerated into useful energy.

2 Recycling, Reuse and Composting

This option places an emphasis on using our resources as thoroughly and efficiently as possible before they are discarded.

4 Landfill

This is a disposal option which should be reserved for only those materials for which the other three options are not suitable.

What can one family do to help conserve our environment? The suggestions listed below for home and office offer ways to make everyone — even grown-ups — partners in the Planet Patrol.

At home...

- Keep mechanical equipment and appliances in good repair to ensure maximum efficiency and product life.
- Lower temperature settings on water heaters, and wash more clothes with cold water.
- Keep thermostats at 65 degrees in winter and 78 degrees in summer.
- Consolidate errands into one trip.
- Install water saving shower heads and faucets, and turn off the water when brushing your teeth.
- Wait until you have a full load to run the washing machine or dish washer.
- Donate your used articles of furniture and clothing to charities for recycling or reuse.
- Take your plastic, glass, paper and aluminum to recycling centers.
- Leave grass clippings on your lawn or start a compost system for your grass and yard clippings and other organic material.
- Buy economy sizes and compact products to reduce the amount of packaging being added to the waste stream.
- Bring your own bags to the store when you shop.
- Return hangers to the dry cleaners for reuse.
- Properly dispose of used motor oil and old batteries.

At work...

- Minimize copies by routing a single copy rather than running multiple copies.
- Use both sides of the paper for copying and writing.
- Recycle soft drink cans and computer paper.
- Carpool or use public transportation.
- Look for ways to use recycled or recyclable materials in your projects.
- Turn the lights off when you're not in the office.

These ideas might seem like very small steps, but remember that when every family pitches in, even just a little, we can all make a world of difference.

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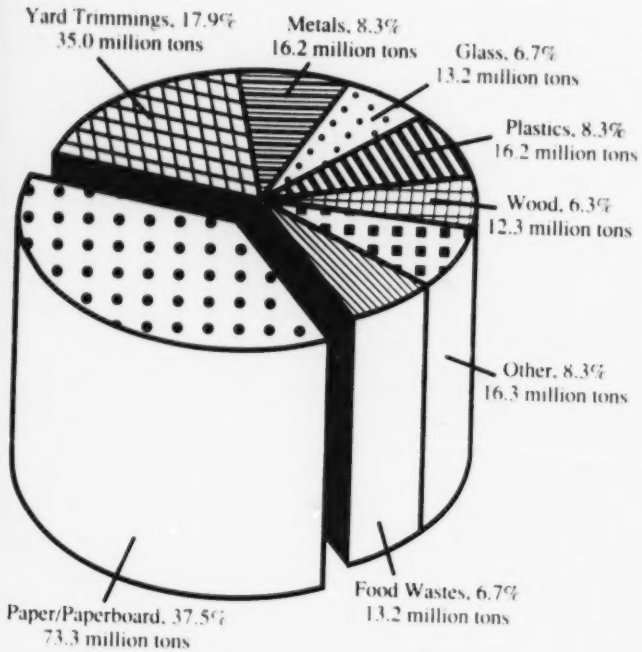
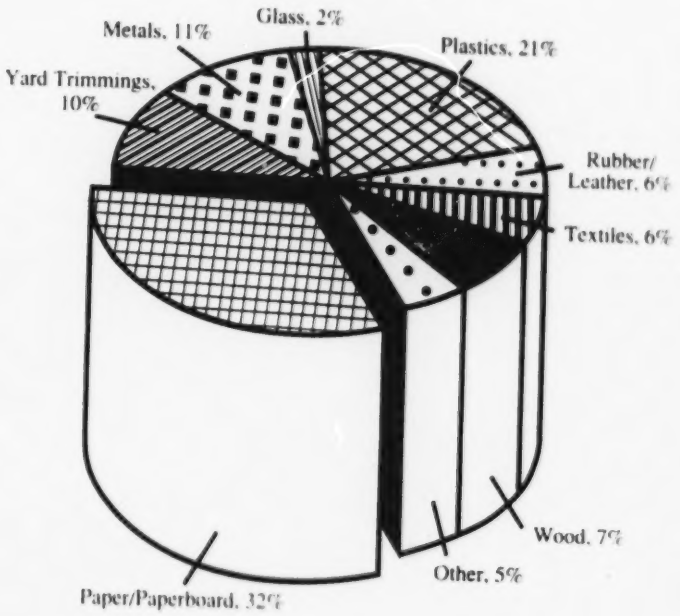
#1 MSW BY WEIGHT, 1990

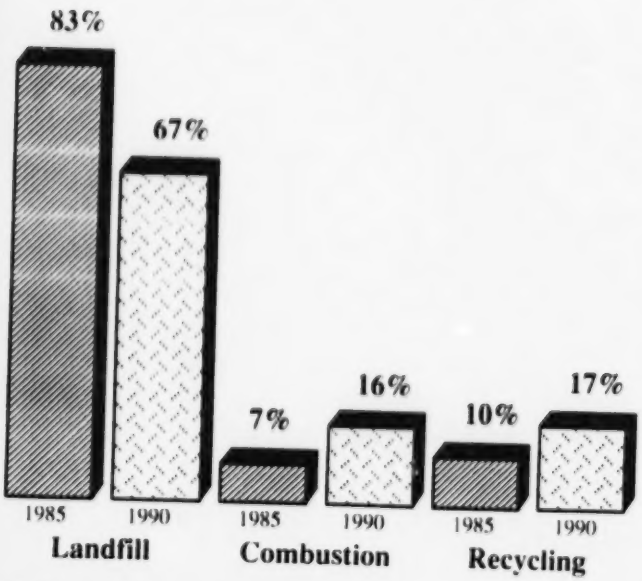


TOTAL WEIGHT = 195.7 million tons

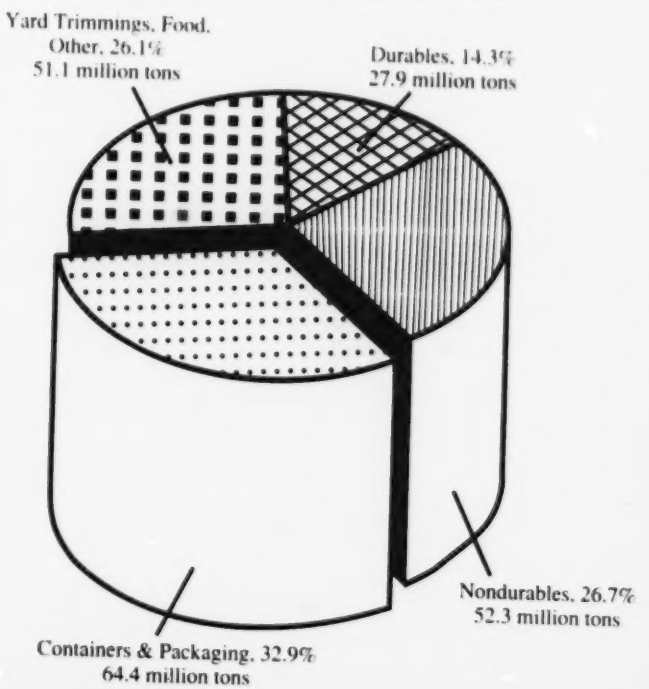
#2 MSW LANDFILL VOLUME, 1990



#3 HOW AMERICA DISPOSES OF ITS MSW



#4 MSW COMPONENTS, 1990



Source: Executive Summary, Characterization of Municipal Solid Waste in the U.S., 1992 Update, July 1992, EPA Office of Solid Waste

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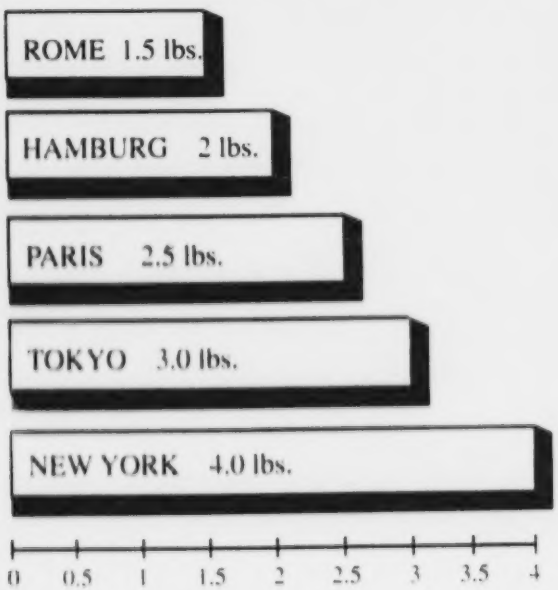
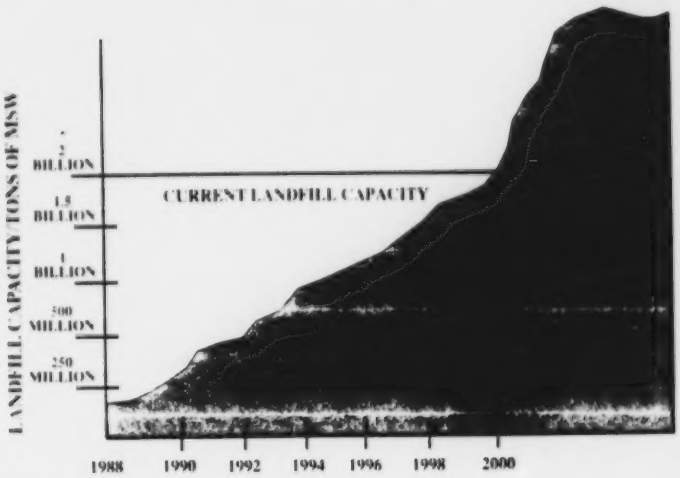
#5 PER CAPITA MSW

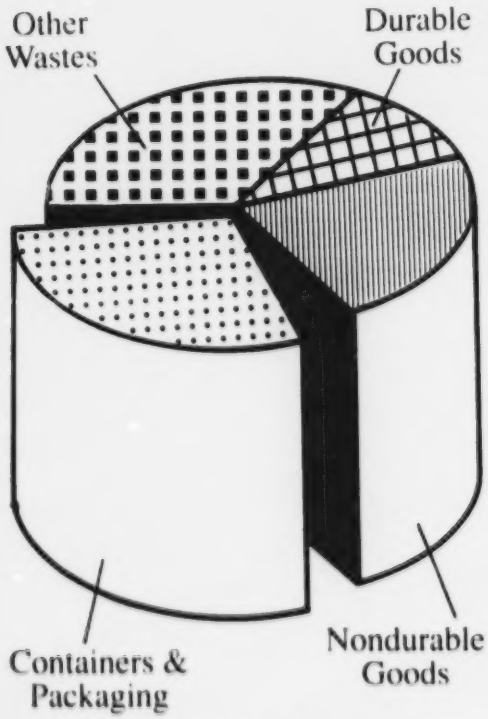


#6 MSW AND DIMINISHING LANDFILL CAPACITY



Source: The Solid Waste Management Problem, A Primer on Municipal Solid Waste Management, Council for Solid Waste Solutions

#7 MSW COMPONENTS



Source: The Solid Waste Management Problem, A Primer on Municipal Solid Waste Management, Council for Solid Waste Solutions

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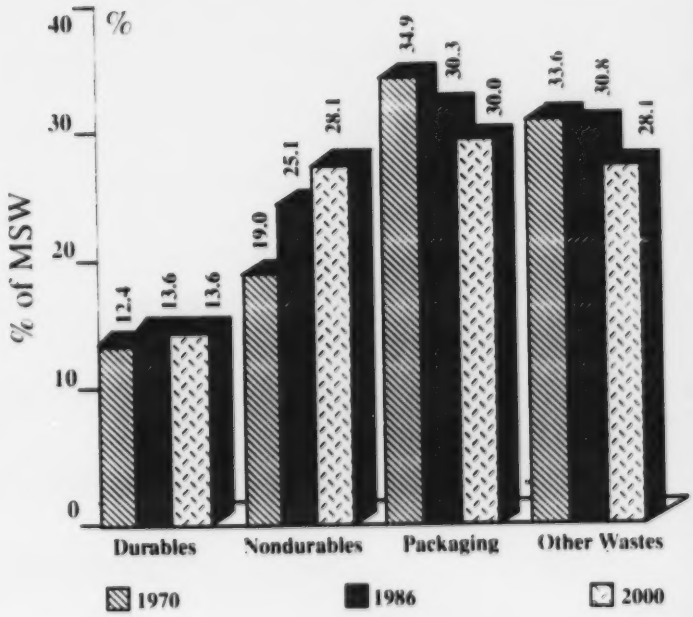
#8 PACKAGING AND CONTAINERS DECLINE AS MSW COMPONENT



Source: The Solid Waste Management Problem, A Primer on Municipal Solid Waste Management, Council for Solid Waste Solutions

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